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The pivotal role of effort beliefs in mediating implicit theories of intelligence and achievement goals & academic motivations

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Abstract

Empirical studies into meaning systems surrounding implicit theories of intelligence typically entail two stringent assumptions: that different implicit theories and different effort beliefs represent opposite poles on a single scale, and that implicit theories directly impact the constructs as achievement goals and academic motivations. Through an empirical study based on a large sample of university students, we aim to demonstrate that relaxing these stringent assumptions, and thereby using the meaning system framework to its full potential, will provide strong benefits: effort beliefs are crucial mediators of relationships between implicit theories and achievement goals and academic motivations, and the different poles of implicit theories and effort beliefs do expose different relationships with goal setting behaviour and academic motivations. A structural equation model, cross-validated by demonstrating gender-invariance of path coefficients, demonstrates that incremental and entity theory views have less predictive power than positive and negative effort beliefs in explaining achievement goals and motivations.

Keywords

Self-theories, implicit theories, effort beliefs, achievement goals, academic motivations, structural equation model

1 Introduction

The theoretical frameworks on meaning systems surrounding implicit theories of intelligence have been employed since the late eighties (Dweck and Leggett 1988), and in the late nineties, Carol Dweck provided a strong stimulus to empirical research based on the framework. In her monograph (1999), Dweck describes the functions and origins of the meaning system and its components: implicit theories of intelligence, effort beliefs, goal setting behaviour, intrinsic and extrinsic motivation and self-regulation strategies. She further appends these with instruments for operationalizing constructs as incremental and entity theories of intelligence, positive and negative effort beliefs, goal choice, and appearance versus normative performance goals (see also: Dweck 2002; Dweck and Master 2008; Dweck and Molden 2005; Grant and Dweck 2003; Molden and Dweck 2006; Plaks, Levy, and Dweck 2009).

Despite the vast potential offered by Dweck´s work, the number of empirical studies that employ the full extent of Dweck's theoretical framework remains very limited, if existing at all. First, the vast majority of these studies choose to simplify the framework through the reduction of related, unipolar constructs into a single bipolar construct. This is typically accomplished by transferring incremental and entity theory constructs into one implicit theory construct, and by transferring positive and negative effort beliefs into one effort belief construct. Taken methodologically, such a reduction would be defensible only when the two related, unipolar constructs prove empirically indistinguishable. Few studies, however, put this explicitly to test. Moreover, where bivariate relationships between related constructs are incorporated, these are in general too weak to suggest the consolidation into a single construct. This is true for incremental and entity positions, where correlations range from an exceptional -.19 (Malmberg and Little 2007), via -.52 (Chen and Pajares 2010), -.55 (Dupeyrat and Mariné 2005), -.58 (Chen 2012) and -.61 (Howell and Buro 2009) to -.74 (Elliott and McGregor 2001) and -.78 (Bråten and Strømsø 2004). And this suggests to be even more true for negative and positive effort beliefs, where associations seem to be even weaker (but published empirical studies absent). Second, there is scarcity of empirical studies that recognize the mediating role of Dweck´s (1999) effort beliefs in the relationships between implicit theories and learning-related

constructs such as achievement goals and academic motivation. Notable exceptions are Blackwell (2002) and Blackwell, Trzesniewski, and Dweck (2007). Studies that do leave out students' beliefs as mediators of the relationships between implicit theories and achievement goals, be it effort beliefs or epistemological beliefs as in the Chen and Pajares (2010) study, typically find no more than very weak direct relationships between implicit theories and achievement goals. In their very recent meta-analysis of 113 empirical studies on implicit theories, Burnette, O'Boyle, VanEpps, Pollack, and Finkel (2012) conclude that 'incremental theories correlate negatively with performance goals and positively with learning goals, although these correlations are small to moderate in magnitude' (p. 19), correlations being -.15 and .19, respectively. All this leaves the body of empirical studies using the full potential of Dweck´s theoretical frameworks conspicuously absent. By means of an empirical study which examines implicit theories, effort beliefs, achievement goals and academic motivation in a large sample of university students, we aim to demonstrate the necessity of employing the full potential of Dweck's self-theories meaning system.

Achievement goals constitute an important component of any self-theories based meaning system. Recent debates on the nature of achievement goals (see e.g. Brophy (2005), Hulleman, Schrager, Bodmann, and Harackiewicz (2010), Senko, Hulleman, and Harackiewicz (2011)), directly impact this study. One issue in that debate is the issue of mastery goals versus the multiple goal perspective. Do different facets of goal constellations, such as mastery and performance goals, all contribute to adaptive learning approaches, or is the mastery goal the single goal perspective that favours performance, interest, and other positive learning outcomes? A second issue in this debate focuses on the role of avoidance goals. Do we need a dichotomy of goals that distinguishes both avoidance and an approach orientation for every goal constellation, or can we do without that strict dichotomy? In this empirical study, we aim to contribute to this debate by applying two goal frameworks that take rather extreme positions on these two issues and are strongly embedded within the self-theories based meaning system tradition of modelling. The first is the Goal Choice framework of Dweck (1999), a framework that postulates one single goal concept, pitting mastery goals against performance goals, rather than assesses mastery and performance goals independently. The second is

the Grant and Dweck (2003) framework of mastery goals, appearance performance-approach goals and normative performance-approach goals, which is based on a multiple goal perspective consisting of approach goals only, lacking any avoidance oriented goal type. Both of these frameworks have been very scarcely applied in empirical research (see Komarraju and Nadler 2013; Sideridis, Vansteenkiste, Shiakalli, and Georgiou et al. 2009), so a further aim of this study is to add to the empirical evidence with regard to the applicability of the two goal frameworks.

The last building block of Dweck's meaning system integrated into this study, is that of intrinsic and extrinsic motivation (Dweck 2002; Molden and Dweck 2000). Entity theory and incremental theory learners are hypothesised to learn for different motives: more intrinsically motivated in the incremental theory case, and a tendency for more extrinsic motivation in the entity theory case. Different from the concepts of implicit theories, effort beliefs, and goal setting behaviour, no attempt has been made to operationalize these different types of motivation within the research tradition of self-theories meaning systems. Therefore, we opted to connect with the concept of academic motivations (Ratelle, Guay, Vallerand, Larose, and Senécal 2007; Vallerand, Pelletier, Blais, Brière, Senécal, and Vallières 1992), in order to investigate the relationships between implicit theories, effort beliefs and goal setting behaviour. Academic motivations are often distinguished in adaptive forms, also called autonomous motivation, and maladaptive forms, or controlled motivation, with the remaining category being the state of lack of motivation, or a-motivation.

This classification into adaptive and maladaptive aspects of learning has been leading in phrasing the broad research hypotheses relevant for our modelling efforts. Our first research question relates the internal structure of implicit theories and effort beliefs: are these best conceptualized as unipolar or bipolar constructs, and what are the relationships between these constructs? The second research question refers to the relationships between both types of constructs, and the other building blocks of the self-theories meaning system. What is the nature of goal setting behaviour based on appearance and normative aspects of performance goals, and intrinsic and extrinsic motivation? In this, it is hypothesized that all concepts are composed of both adaptive (incremental theory, positive effort belief, learning goals and appearance performance goals, autonomous motivation) and

maladaptive (entity theory, negative effort beliefs, normative performance goals, controlled motivation) manifestations. As a last research question, we look into the relationships with academic performance and gender, where the gender difference investigation serves two different roles: to find indications of level differences, but as important, to establish structural invariance of the SEM over two important subsamples.

2 Method

2.1 Participants and Educational Context

This study involves six approximately equally sized class years composed of first-year students (academic years '06/07' 'to '11/12') of a Business and Economics School in the southern part of the Netherlands. This school's program deviates from a conventional European university education in two important ways. First, it employs a student-centred learning approach called "problem-based learning". Second, it has a strong international orientation— the study is fully in English and attracts primarily non-Dutch students. Of the 4594 students included in this study, 71% have an international background (mostly European, with somewhat more than 50% originating from German speaking countries in Europe); the remaining 29% are Dutch. With regard to gender, 63.3% of the students are male and 36.7% are female. The participants' ages ranged from 17-31, with an average age of 20.21 years, but most students were in their teens, the median age being 19.82 years. The educational settings have not changed over these class years, other than teaching assistants, fulfilling the role of tutors in the problem-based systems, being refreshed each year; lecturers stayed the same. Exams in subsequent years are equivalent.

2.2 Materials

Implicit theories of intelligence. Measures of both entity and incremental implicit theories of intelligence were adopted from Dweck's Theories of Intelligence Scale – Self Form for Adults (1999). This scale consists of eight items: four Entity Theory statements (e.g., '*You have a certain amount of*

intelligence, and you can't really do much to change it') and four Incremental Theory statements (e.g., '*You can always substantially change how intelligent you are*'). Combining both subscales after reversion of Entity Theory scores generates the Implicit Theory scale.

Effort beliefs. Measures of effort beliefs were drawn from two sources: Dweck (1999) and Blackwell (2002). Dweck provides several sample statements, which are designed to portray effort as a negative concept—i.e. exerting effort conveys the view that one has low ability, and effort as a positive concept—i.e. exerting effort is regarded as something which activates and increases one's ability. Of these two sets of statements (see Dweck 1999, p. 40), the first are used as the initial item on both subscales. The following statements correspond to the Effort Negative belief subscale: '*If you have to work hard on some problems, you're probably not very good at them*', and for the Effort Positive belief subscale: '*When you're good at something, working hard allows you to really understand it*'. In addition, Blackwell´s full sets of effort beliefs (2002) were used, comprising five positive and five negative items (see also Blackwell et al. 2007). An example item for a perception of effort as negatively related to ability is *'To tell the truth, when I work hard at my schoolwork, it makes me feel like I'm not very smart'*, while the item *'The harder you work at something, the better you will be at it'* expresses the view that effort leads to positive outcomes. Combining both subscales after reversion of Effort Negative scores generates the Effort Belief scale.

Achievement Goals. Goals have been operationalized in two ways. Following Dweck's plea to apply measures that pit learning goals against performance goals rather than assess learning and performance goals independently, we adopted the Goal Choice Items Questionnaire (Dweck 1999, pp. 185-186) (the final item has been translated into a Likert scale format in order to match the format of the other three items). After the change this item became: '*If I had to choose between getting a good grade and being challenged in class, I would choose for being challenged.*' Secondly, we have applied the Grant and Dweck (2003) instrument, which distinguishes the two learning goals Challenge-Mastery and Learning, as well as four types of performance goals. Of the performance goals, two are of appearance nature: Outcome and Ability Goals, and two of normative nature: Normative Outcome and Normative Ability Goals. In their empirical studies, Grant and Dweck (2003) opted for a reduced

four-factor model separately merging the two normative goals and the two learning goals, respectively. In contrast, Donnellan (2008) gives legitimate reasons for preserving the full six-factor structure, an approach we will follow as well.

*Academic Motivation Scale***.** The AMS (Vallerand et al. 1992) is based upon Ryan and Deci's (2000) model of intrinsic and extrinsic motivation. The AMS consists of 28 items, to which students respond according to the question stem "*Why are you going to college?*" There are seven subscales on the AMS, of which three belong to the intrinsic motivation scale and three to the extrinsic motivation scale. In intrinsic motivated learning, the drive to learn is derived from the satisfaction and pleasure of the activity of learning itself; external rewards do not enter consideration. Intrinsic motivation subscales are Intrinsic Motivation to Know (learning to experience the satisfaction and pleasure of understanding something new), Intrinsic Motivation to Accomplish (learning to experience the satisfaction and pleasure of accomplishing something), and Intrinsic Motivation to Experience Stimulation (learning to experience stimulating sensations). Conversely, externally motivated learning refers to learning that is a means to some end, and therefore not engaged for its own sake. The three extrinsic motivation subscales are Identified Motivation, Introjected Motivation, and External Regulation. The three constitute a motivational continuum reflecting the degree of a student's self-determined behaviour. The component most closely related to intrinsic motivation is Identified Motivation: the student comes to value learning as important and therefore performs it out of choice, but still does so for extrinsic reasons such as for the realization of personal goals. Together with the three facets of intrinsic motivation, Identified Motivations constitutes the concept of autonomous motivation. Motivation is Introjected when the formerly external source of motivation has been internalized. Externally Regulated learning occurs when learning is guided by external means, such as rewards. These two components shape controlled motivation. The final scale, A-Motivation, constitutes the extreme of the continuum: the absence of regulation, either externally directed or internally.

Academic Performance. Three different measures of academic performance are used, all based on final exam course grades in the three courses that constitute the academic program of students

under study in their first half semester. These are the grades in two service courses, Mathematics Exam and Statistics Exam, and the grade in the integrated course covering organizational theory and marketing, labelled as Social Sciences Exam. All performance measures are based on official school reports. In the design of structural models, these three exam grades are treated as indicators of one latent Academic Performance construct.

2.3 Procedure

In the first eight weeks of their first academic semester, the students followed two required, parallel courses: an integrated course on organizational theory and marketing, two subjects from the behavioural sciences domain, and an integrated course on mathematics and statistics. In the first three weeks of the term, the students are asked to complete self-report questionnaires on implicit theories, academic motivations, and achievement goals as part of a data-analysis directed student project for statistics. All students consented that their data, in anonymous format, could be used for educational and research purposes.

2.4 Statistical Analyses

Beyond correlational analyses and the investigation of gender differences with *t*-tests for independent populations, this study applies structural equation modelling. Modelling is based on covariance matrices using LISREL 8.80. Structural equation models were estimated using a two-step approach. The design of measurement models for the several instruments constitutes the first step, and the estimation of the structural model specifying the relationships between measurement models the second step (Kline, 2005). To prevent capitalization on chance in the assessment of all individual paths suggested by the full model of the meaning system, a very conservative criterion for statistical significance of model parameters is chosen: a significance level of .001 is required for the introduction of any structural path. Next, the quality of the final model is assessed in a split-sample approach: the model is re-estimated on gender specific subsamples to investigate invariance of levels, model structure and parameter estimates. In the investigation of these gender differences, the same conservative required significance levels for any breakdown of gender invariance is chosen: .001.

With regard to the assessment of model fit: in large sample sizes, the χ^2 test statistic is prone to model rejection in virtually any formal test of significance (Hancock and Mueller 2010; Kline, 2005). Since our sample size of 4594 is extreme, χ^2 tests and χ^2/df ratios appear indeed to be uninformative. Therefore, we follow Hancock and Mueller (2010) and include for data-model fit their recommended list of indices: for absolute indices, the SRMR, falling below .08; for parsimonious indices, RMSEA and its 90% CI, both falling below .05; and for incremental indices, NFI, NNFI, and CFI, all beyond .95. Since not only the sample size, but also the number of manifest variables (78) in this study is exceptional, we provide the correlation matrix of all scales under study (Table 1), rather than of all manifest variables.

***** Table 1 about here *****

3 Results

3.1 Unipolar or bipolar self-theory constructs

In our sample between Incremental and Entity Theory subscales, we found a correlation equal to -.74; between Effort Positive and Effort Negative belief subscales it was -.35 (see Table 1). The first outcome is in line with previous findings. For example, Elliot and McGregor (2001) report a correlation of -.74 between implicit theories, whereas Levy, Stroessner, and Dweck (1998) report correlations between -.69 and -.86 at item-level. No reference values are available for correlations of effort beliefs, since every previous study merges the two unipolar subscales into one. Neither association found in our study is strong enough to make the creation of one, bipolar scale an inevitable step in the empirical analysis. Only the reliabilities would profit from the creation of bipolar scales: where Cronbach's alpha values of the unipolar incremental and entity theory subscales are equal to .84 and .83, that of the bipolar implicit theory scale equals .90. And where alpha values of the unipolar positive and negative effort belief subscales equal .66 and .72, that of the bipolar effort belief scale equals .75 (see Table 2).

***** Table 2 about here *****

3.2 Structural equation model of self-theory constructs

The advantage of incorporating the two poles of implicit theories and the two poles of effort beliefs is clearly visible from the outcome of a structural equation modelling of these constructs—see Fig. 1 for the path diagram of the structural part of the model. Model fit is adequate (SRMR = .033; RMSEA = .038 and 90% CI RMSEA = .036 - .041; NFI = .98; NNFI = .98; CFI = .98).

Latent factor correlations between both implicit theories and between both effort beliefs are -.86 and -.57, respectively. As is to be expected, these correlations are somewhat stronger than those between the scales containing the four constructs, since in the structural model latent factor correlations are disposed of measurement error. More remarkable are the structural path coefficients, expressed as betas or standardized estimates. In line with Dweck's (1999) self-theories, entity theory is the main predictor of the negative effort belief and incremental theory the main predictor of the positive effort belief. Nevertheless, there are substantial secondary cross-over effects, both with positive signs. In other words, although the bivariate correlation between entity theory and positive effort belief is negative (r = -.15, see Table 1), in the simultaneous model, entity theory contributes positively to the positive effort belief ($\beta = 0.33$; see Fig. 1).

***** Fig. 1 about here *****

Furthermore, although the bivariate correlation between incremental theory and negative effort belief is negative (r = -.21, see Table 1), in the simultaneous model incremental theory contributes positively to the negative effort belief ($\beta = 0.44$). Thus both positive and negative effort beliefs are explained by both poles of implicit theories, whereby the weights of the two implicit theories differ, but not the signs of the paths. If we merge the unipolar constructs into a bipolar construct, and next design a structural equation model for the bipolar version of the self-theories model, where the latent effort belief factor is explained by the latent implicit theory factor, the model would be described by a

beta estimate of 0.43, and fit indices being less satisfactory (SRMR = .050; RMSEA = .066 and 90% CI RMSEA = .068 - .076; NFI = .95; NNFI = .95; CFI = .96).

3.3 A person-based modelling approach

Most empirical research by Dweck and co-authors takes a person-based modelling approach, rather than a variable-based approach. In that approach subjects are assigned based on questionnaire responses to a category of incremental theorists or entity theorists, or an indefinite category in between. The statement that '*most individuals generally endorse either an entity theory or an incremental theory, and each theory occurs with equal frequency.*' (Molden and Dweck 2006, p. 194) supports this approach. Based on the distribution of implicit theory scores in our sample (see Fig. 2), the latter part of the claim—that each theory occurs with equal frequency—is corroborated: the distribution is rather symmetric around the mean (M = 4.48, SD = 1.14), just above the neutral value of four. Nevertheless, the distribution is also unimodal (approximately normal), which is an attractive property for a variable-based modelling approach, but not for a person-based modelling approach.

***** Fig. 2 about here *****

Our findings do not corroborate the former part of the claim—that most individuals generally endorse either an entity theory or an incremental theory. In our large sample, the largest group is that of students with an indefinite position with regard to implicit theories. Applying the classification rule used in Blackwell et al. (2007)—classifying students according to their implicit theory and effort belief scores on the basis of M ± 1SD, results in Table 3 containing the intermediate scoring students as the largest group by far.

***** Table 3 about here *****

Effort belief scores tend to be higher than neutral levels for most students, but again are unimodally distributed. Only 11.3% (4.3% + 7.0%) of the students fall into one of the two categories of consistent profiles if the assumptions of bipolarity are valid: entity theorists with negative effort beliefs, or incremental theorists with positive effort beliefs.

For these reasons, a variable-based model approach seems to fit data characteristics better than a person-based approach. The fact that those Table 3 cells outside the diagonal contain substantial amounts of students confirms the main conclusion of the structural model, namely that effort beliefs are only loosely coupled with implicit theories.

3.4 Bipolar achievement goal construct

Dweck's (1999) self-theories framework contains another bipolar construct based on the bipolarity of the items themselves, rather than merging the two unipolar subscales into a single bipolar scale. This is the Goal Choice construct, which pits learning against performance goals. The internal reliability of the construct, however, is problematic. The Cronbach's alpha index equals 0.42, indicating that different items represent different contexts that evoke different goal-setting behaviours. The limited reliability is a stable result: in splitting our sample into the six different class years, we found reliabilities of .38, .41, .39, .36, .47, and .46 in academic years '06/07' to '11/12'. These reliabilities cannot be improved by deletion of any individual item. The fourth item, added to Dweck's (1999) 3-item Goal Choice instrument, appears to be the strongest item within the construct: its deletion would result in a strong decrease of reliability. In a literature search for applications of this instrument, we could identify only one single empirical study applying the Goal Choice construct: Kennett and Kefer (2006). That study does not report however any reliabilities and finds the construct to be unrelated to the effort construct applied and no more than very weakly related to Dweck's Implicit Theory construct. For these reasons, the Goal Choice construct has not been included in the modelling part of our analysis.

3.5 Relationships between self-theories, achievement goals, academic motivations, and performance

We have assessed the external validity of unipolar constructs for implicit theories and effort-beliefs by investigating the relationship between self-theories constructs as compared to goal-setting and achievement motivation constructs. This is done within both a descriptive context—looking at bivariate correlations—and within a modelling context—deriving a structural equation model and

focusing on model-induced correlations. Table 1 contains all bivariate correlations of the scale constructs, whereas Table 4 contains standardized estimates of the structural equation coefficients.

***** Table 4 about here *****

The correlations in Table 1 exhibit several interesting patterns. First, they bring us further evidence that the reduction of unipolar scales to one bipolar scale is not corroborated. Correlations of the Incremental Theory subscale (first column) and Implicit Theory scale (third column) should have been equal, and equal to the negative of the correlations of the Entity Theory subscale (second column), to justify the construction of one Implicit Theory scale. With the exception of the last three rows, containing correlations with academic performance, this condition is not or only approximately satisfied. Similarly: to justify the use of one Effort Belief construct, correlations in columns four and six should be approximately equal, and the negative of those in column five, which is again far from true. In some cases, like the Normative Ability Goal and Introjected Motivation, correlations of both Positive and Negative Effort even have equal signs, making the corresponding correlations of the Effort Belief construct indeterminate. Where the symmetry between Positive and Negative Effort breaks down, it is Positive Effort that demonstrates stronger bivariate relationships with both goals and motivations, than Negative Effort. Second, a comparison of columns one and two with columns four and five demonstrates that effort beliefs dominate implicit theories in the bivariate relationships with achievement goals and academic motivations, with External Regulation being the single exception. Differences are large: no correlation of Negative Effort with any of the goal or motivation variables is larger than .2 in absolute sense, whereas several of the Positive Effort correlations are.

Second: Effort Positive and Effort Negative demonstrate much stronger relationships with achievement goals and academic motivations, with again one single exception: A-Motivation. Again, differences are large. No correlation of Entity or Incremental Theory with any of the goal or motivation variables is larger than .2 in absolute sense, whereas several of the Effort Positive correlations are.

Third: even if we permit ourselves to neglect the reliability problem of the Goal Choice scale: the correlational patterns that it demonstrates with implicit theories, effort beliefs, other achievement goals, academic motivations, and academic performance constructs are not that unique as to make this bipolar construct an indispensable building block of a self-theories based model.

Fourth: the classification of Outcome Goal as a separate goal type, different from learning and performance goals (Hulleman et al. 2010), is supported by correlation patterns found in Table 1. That is so most strongly in correlations with External Regulation: performance goals correlate positively with External Regulation, the two learning goals correlate weakly and negatively with it, and Outcome Goal does not correlate at all with it.

Fifth: measurements of academic performance demonstrate diverse relationships with self-theoretic concepts, achievement goals and academic motivations. Performance in the two quantitative subjects mathematics and statistics is most strongly related to achievement goals, specifically, the two mastery goals and the intermediate Outcome Goal. Implicit theories, effort beliefs, and academic motivations are more weakly related to these performance components. In contrast, performance in the social science subjects, organizational theory and marketing, are most strongly related to academic motivations. In the assessment of the differences in these outcomes, it is important to realize that subjects as mathematics and statistics are service courses within a business and economics program, whereas subjects as organizational theory and marketing are at the kernel of these programs. That difference is very likely to affect relationships between academic motivation and performances. Bivariate relationships between effort beliefs and performance components are modest in size, with expected sign: Effort Positive beliefs contribute to better performance, and Effort Negative beliefs are detrimental to performance. Bivariate relationships of performance components with Incremental and Entity Theories are again modest in size, but signs are opposite to what was expected: Incremental Theory correlates negatively with performance, Entity Theory positively. Apparently, the relationships between performance components and self-theoretic constructs are a complex one, which can only be made explicit by the incorporation of both implicit theories and effort belief constructs.

When all relationships are simultaneously estimated by means of a structural equation model, most of the above mentioned patterns become visible in the beta and gamma estimates provided in Table 4, in standardized format. Effort Positive and Effort Negative are key latent constructs in the explanation of latent achievement goal and academic motivation constructs. Effort beliefs dominate the direct role of implicit theories in explaining these constructs, except for the Normative Ability Goal. In the explanation of other goals and motivations, the role of implicit theories is mediated through the effort beliefs. (SRMR = .052; RMSEA = .032 and 90% CI RMSEA = .031 - .032; NFI = .97; NNFI = .97; CFI = .98)

3.6 Gender differences

Most constructs in this study demonstrate gender differences in levels that uniformly favour female students over male students. Given the large sample size, most of these gender differences are statistically significant (see Table 2). However, their size is at most modest: the highest Cohen *D*-value, for the Outcome Goal, equals .25. Beyond Outcome Goal, relative large gender differences favouring females are found in two of the motivation scales that contribute to an adaptive learning approach: Intrinsic Motivation to Know, and Identified Motivation. The single two scales where male scores are higher than females refer to components of non-adaptive learning behaviour: A-Motivation, the state of lacking any type of academic motivation, and the Normative Ability Goal, the desire to look smarter than other students in class. Hence more than it is the size of these gender differences, it is the consistency in the pattern over goals and motivations that provide the strongest signal in Table 2.

Gender differences are however restricted to levels, and do not show up in covariance structures (no single structural difference reaches the conservative .001 level). Re-estimating the structural equation model allowing for two gender groups, produces significant differences in latent factor means in line with the outcomes of the *t*-tests, but does not result in any breakdown of gender invariance of model structure or structural parameter estimate. Model fit of the 2-group structural equation model is again adequate, with only the absolute fit index SRMR at a somewhat weaker level, because of the

conservative model modification criterion (SRMR = .060; RMSEA = .033 and 90% CI RMSEA = .032 - .033; NFI = .96; NNFI = .97; CFI = .97).

4 Discussion

Although frameworks of self-theories have been shown to represent important determinants of human behaviour in a range of different fields, this study suggests that we have not used this theoretical framework to its full potential. Three crucial adaptations in the way self-theories based empirical research is designed have been proposed. The first refers to the much looser coupling of entity and incremental positions, as well as that of negative and positive effort beliefs. This is in direct contrast to the strict opposite directedness that is implicitly assumed when basing empirical research on bipolar constructs. Both entity and incremental positions —and especially negative and positive effort beliefs— represent very different relationships with aspects of behaviour relevant for achievement settings, such as learning. Normative Ability Goal setting and controlled regulation of learning are excellent examples where these unipolar constructs serve as more predictive measures than bipolar ones. Other researchers have addressed this issue. Dupeyrat and Mariné (2005) for example conclude that 'the correlation coefficient between the two factors was not strong enough to support that entity and incremental theories are two opposite ends of a continuous and unidimensional construct' (p. 56). However, findings as these have not yet changed the dominant research tradition in modelling self-theories based meaning systems, as becomes apparent from Burnette et al.'s (2012) recent meta-analysis.

Our study suggests that a second amendment may have an even stronger impact: the incorporation of effort belief constructs as mediators. They mediate the relationships between implicit theories on the one hand, and other descriptions of human behaviour in achievement settings, such as achievement goal setting and academic motivation, on the other hand. Our outcomes indicate that such a mediating relationship strongly dominates the direct impact of implicit theories. This outcome is fully in line with those derived in the Chen and Pajares (2010) study, which study introduced

epistemological beliefs as mediators of the relationships between incremental and fixed implicit theories at the one side, and task, performance approach and performance avoid goals at the other side. The mediating role of these epistemological beliefs appeared to be crucial in their model, in the case of approach goals even constituting the sole indirect path from implicit theories to achievement goals, as does the role of effort beliefs in our study. However, although effort beliefs played a prominent role in Dweck's (1999) monograph introducing the self-theories meaning system, empirical research mostly focussed on the derivation of relationships between implicit theories, and goal setting behaviour and self-regulation of learning (Burnette et al., 2012). Given that the large majority of empirical studies based on the self-theories framework have *not* explicitly conceptualized effort belief constructs, we assert that the full potential of self-theoretical frameworks is yet to be achieved.

A third suggestion refers to modelling approaches. The classification of subjects into clearly-distinguishable types of implicit theories and types of effort beliefs appeared to be less straightforward than assumed. On top of that, the relationships are more complex than incremental theories and positive effort beliefs influencing adaptive achievement goals and adaptive academic motivations only, and entity theories and negative effort beliefs influencing mal-adaptive achievement goals and mal-adaptive academic motivations only. These arguments together suggest that person-based modelling approaches may well suffer from loss of power relative to variable-based modelling approaches.

Related to the development of achievement goal theory, this study contributes in applying Dweck's (1999) Goal Choice Items Questionnaire and Grant and Dweck's (2003) instrument for appearance and normative achievement goals. Empirical studies based on these instruments are not numerous. Validation of the Goal Choice instrument would imply an important contribution in the debate on mastery goals versus the multiple goal perspective (Hulleman et al. 2010), the instrument being the sole explicitly one-dimensional design of goal constellations, by pitting learning and performance goals against each other. However, the instrument could not be validated, neither in the complete sample, nor in any of the six different year classes. Apparently, achievement goal setting in learning situations is too differentiated to get described by one, bipolar construct, in a very similar vein

as that both implicit theories and effort beliefs are too differentiated as to represent them in single, bipolar constructs.

The adoption of a multiple goal perspective by explicitly distinguishing different learning goals, and different performance-approach goals of both appearance and normative types, as in the Grant and Dweck (2003) framework, did achieve validation in this empirical study. Internal validation is expressed by the reliabilities of the six scales ranging from satisfactory to good, and the circumstance that the six scales sufficiently differentiated from each other. Our study endorses the conclusions of Donnellan (2008) in that respect. To this, our study adds pieces of external validation of the goal framework: relationships with implicit theories, effort beliefs, academic motivations, and academic performance. Correlations with these concepts are sufficiently different for the six goal constellations as to justify a multiple goal perspective. In specific, the correlational pattern of the Outcome Goal construct differs so much from those of the other three performance goals, that this supports the suggestion by Hulleman et al. (2010) to position Outcome Goals in a separate category, somewhat in between learning and performance goals. Both correlational analysis and the analysis of gender differences suggest that the two normative goals, Normative Outcome and Normative Ability Goals, take rather unique positions, thereby rejecting the suggestion in the Grant and Dweck (2003) study to merge both constructs into one factor.

The pivotal role of effort beliefs is clearly articulated in the estimates of the structural equation model. Except for the Normative Outcome Goal, in the explanation of all types of goal setting behaviour, and all aspects of academic motivation, the role of implicit theories is dominated by the role of effort beliefs. The Effort Positive belief is central in the direct explanation of the adaptive types of goal setting behaviour, the learning and appearance goals, and of the academic motivations that constitute autonomous motivation (except the motivation to accomplish, where indirect paths through goal setting dominate the direct path). The Effort Negative belief has a more modest role, both in terms of the number of paths originating from it, as the size of the beta’s of these paths. As expected, it explains the controlled types of motivation, next to two goal setting types.

Suppression effects, in combination with the conservative significance levels applied, determine the specification of the equation explaining the latent academic performance factor. In contrast to expectations, Incremental Theory has a negative beta weight in this equation. However, this is in line with the bivariate relationships, as visible from Table 1. All three performance scores, mathematics, statistics, and social sciences, correlate negatively with Incremental Theory, and positively with Entity Theory. That is, maladaptive rather than adaptive types of implicit theories contribute to performance, with the remark that the size of the correlations is small. When looking at bivariate relationships of performance scores and effort beliefs, expectations with regard to adaptive and maladaptive beliefs come true: Effort Negative beliefs have a consistent negative impact on the three performance measures, Effort Positive beliefs a positive impact (be it that two do not pass the required .001 level). The same pattern as in the bivariate relationships is recognized in the simultaneous equation: both Incremental Theory and Effort Negative carry negative beta weights. This is also true for the two components of controlled motivation, Introjected Motivation and External Regulation, whereas Challenge Mastery Goal, as well as the Normative Outcome Goal, contributed positively to performance. Except for the direction of normative goal setting, these outcomes corroborate the research hypotheses. The circumstance that all types of goal setting behaviour, including the normative types that are hypothesized to be maladaptive, contribute to all three performance measures (see again Table 1), may find its explanation in the selective nature of the first year program in the school.

This study results in very consistent gender patterns, favouring female students, both in terms of higher mean scores on adaptive behaviour, and lower mean scores on behaviour. But gender differences are limited to levels; structural relationships are shared by both gender groups. Such a consistent gender pattern compares well with findings from many other studies that more often than not produce more ambiguous gender patterns (see e.g. Linnenbrink-Garcia, Tyson, and Patall 2008). Future research should find an answer to the question if this consistent pattern can be attributed to the specific framework of adaptive versus maladaptive learning behaviours, or results from the combination of framework and characteristics of the sample.

5 Conclusion

Self-theories based meaning systems constitute an important category of social-cognitive applications to learning, as evidenced by the meta-analysis of Burnette et al.'s (2012). At the same time, explanatory power of the studies evaluated in the meta-analysis is modest at most. Main result of this study is providing several potential causes of these disappointing outcomes, together with suggestions to improve. The dominant research tradition to not distinguish adaptive from maladaptive aspects of implicit theories, and of effort beliefs, represents a first, crucial limitation. Entity and incremental views, and even stronger, negative and positive effort beliefs, appear not to be each other's antipoles. Next, the introduction of effort beliefs as mediators between implicit theories and remaining components of the meaning system, goal setting behaviour and intrinsic and extrinsic motivation, appears to be powerful. Not only do effort beliefs dominate the role of implicit theories in explaining goals and motivation, they also allow for a more consistent characterization into adaptive and maladaptive facets as implicit theories do.

The main implication of this contribution to the practice of school learning is related to this crucial role of effort. Dweck's monograph (1999) gave rise to school intervention programs directed at changing students' self-theories. Having students adopt an incremental theory of intelligence is at the basis of many of these programs (see e.g. Espinoza, Arêas da Luz Fontes, and Arms-Chavez 2014). Empirical outcomes of studies as Espinoza et al. (2014) suggest that beyond type of self-theory adopted, effort attributions of academic success by both students and teachers are important antecedents of learning behaviours. This study adds the crucial importance of another aspect of learning effort: the self-perception of students on the role effort plays in learning. Taking these two empirical outcomes together, and combining it with the more loose coupling of implicit theories and effort beliefs we find in this study than often hypothesized in frameworks of self-theories, suggests that intervention programs may profit from shifting some of their focus toward adapting effort beliefs and effort attributions, away from implicit theories.

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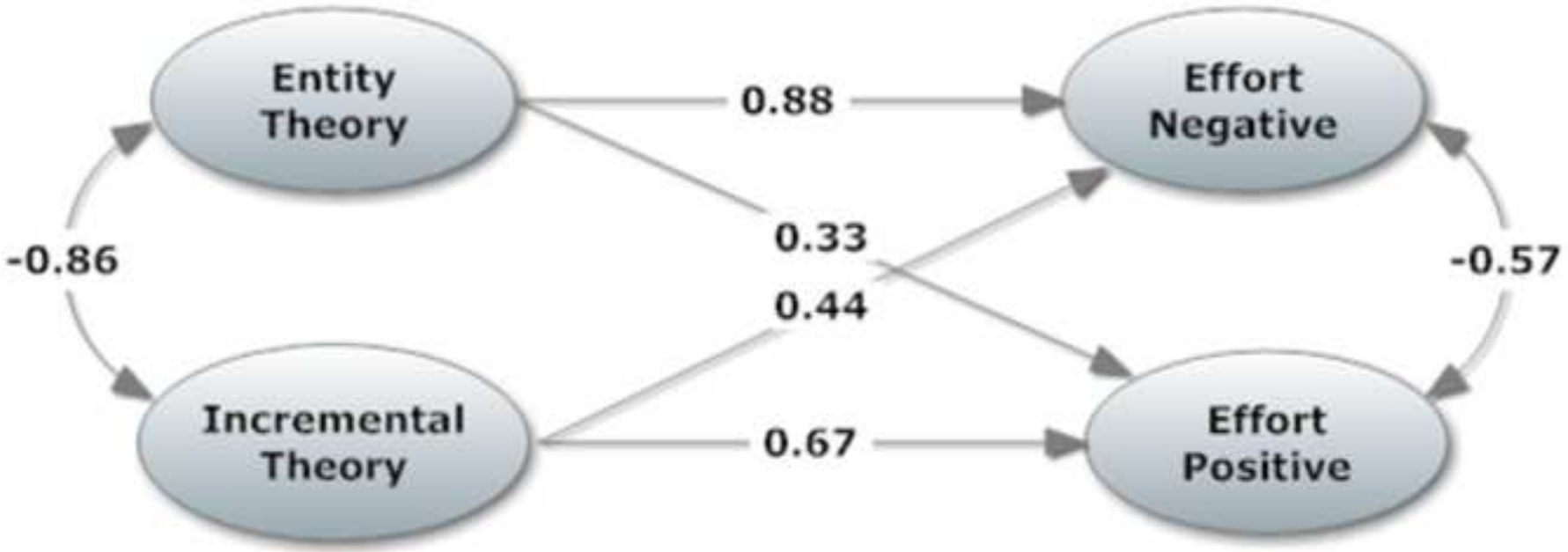
Figure1


Entity Theory
Incremental Theory
Effort Negative
Effort Positive
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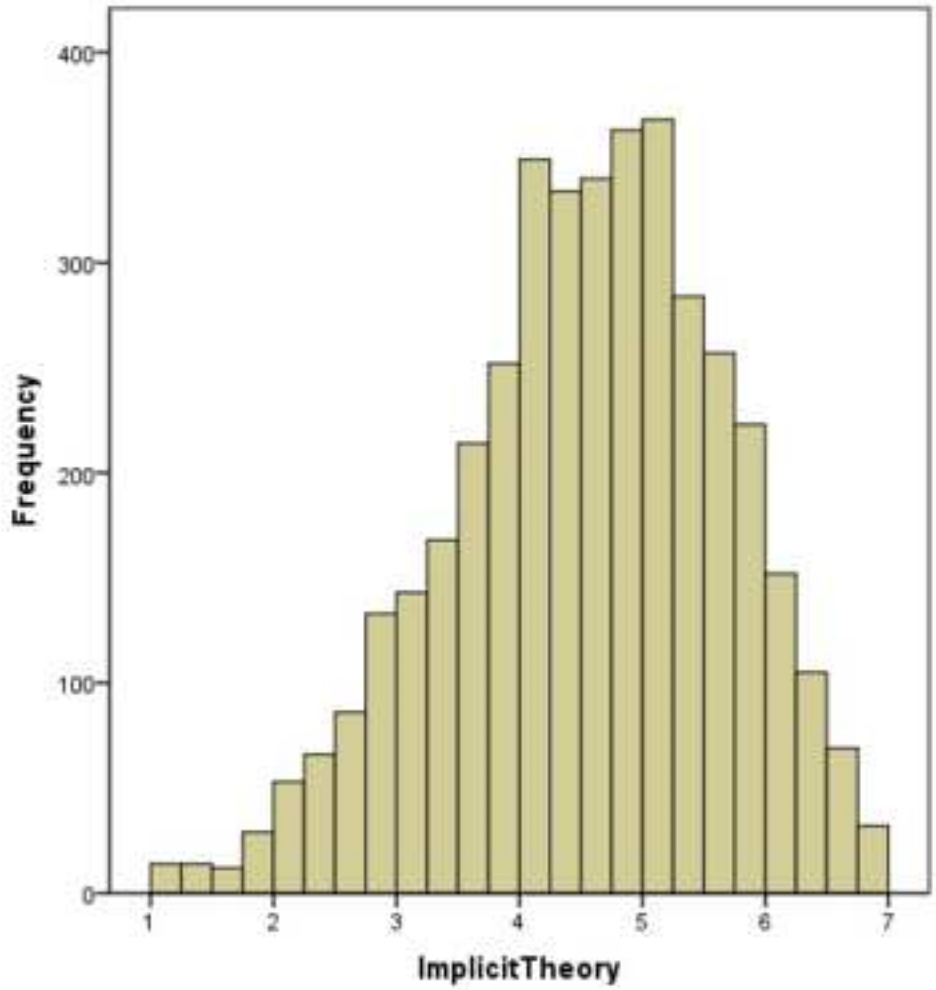
0.33
0.44
0.67
-0.86
-0.57

Figure2


Frequency
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300
200
100
0
1
2
3
4
5
6
7
ImplicitTheory

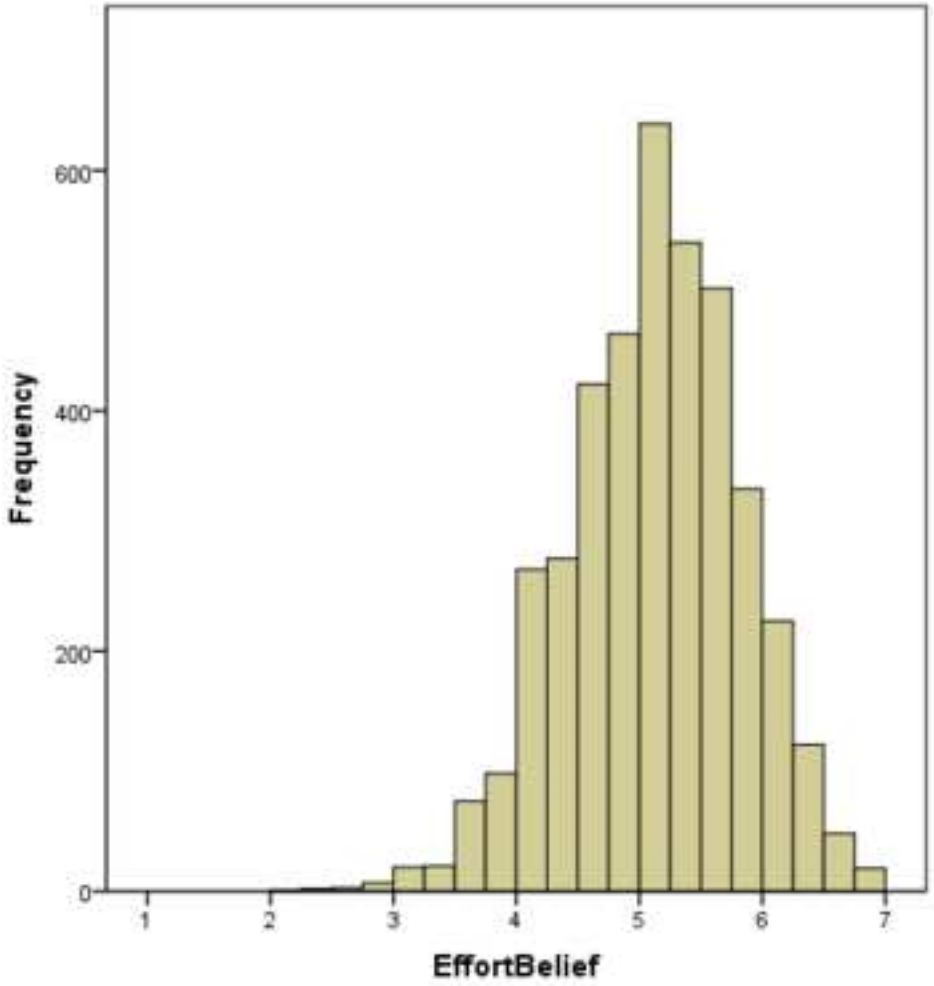
Frequency
600
400
200
0
1
2
3
4
5
6
7
EffortBelief

Table1

Table 1

Pearson product-moment correlations amongst all scales.

Scale	1.	2.	3.	4.	5.	6.	*7.*	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.
1. Incremental Theory																							
2. Entity Theory	-.74																						
3. Implicit Theory	.93	-.94																					
4. Effort Positive	.27	-.15	.22																				
5. Effort Negative	-.21	.33	-.29	-.35																			
6. Effort Belief	.28	-.31	.32	.78	-.87																		
7. Goal Choice	*.15*	*-.18*	*.18*	*.23*	*-.26*	*.30*																	
8. Learning Goal	.15	-.12	.14	.31	-.16	.27	*.19*																
9. Challenge Mastery Goal	.12	-.08	.10	.21	-.10	.18	*.24*	.75															
10. Outcome Goal	.18	-.13	.16	.36	-.18	.31	*.09*	.55	.44														
11. Ability Goal	.19	-.07	.14	.33	-.09	.24	*.05*	.19	.16	.38													
12. Normative Outcome Goal	.09	-.01	.05	.20	-.05	.14	*-.09*	-.05	-.09	.13	.50												
13. Normative Ability Goal	.03	.08	-.03	.06	.08	-.02	*-.12*	-.11	-.08	-.03	.47	.76											
14. Intrinsic Motiv. to Know	.11	-.08	.10	.28	-.16	.25	*.18*	.29	.23	.30	.26	.16	.09										
15. Intrinsic Motiv. to Accomplish	.09	-.07	.09	.09	.02	.04	*.12*	.03	.07	.02	.16	.17	.15	.21									
16. Intrinsic Motiv. Stimulation	.11	-.05	.09	.22	-.11	.20	*.10*	.28	.25	.26	.20	.10	.08	.58	-.17								
17. Identified Motivation	.12	-.09	.11	.21	-.09	.17	*.13*	.17	.14	.21	.21	.18	.11	.34	.40	.09							
18. Introjected Motivation	.09	.01	.04	.18	.05	.06	*-.05*	.13	.12	.16	.36	.25	.26	.23	.30	.24	.37						
19. External Regulation	.06	-.01	.03	.05	.10	-.04	*-.08*	-.04	-.04	.01	.16	.21	.19	.05	.61	-.30	.53	.38					
20. A-Motivation	-.03	.07	-.06	-.01	.01	-.02	*-.08*	.07	.07	.05	-.01	-.06	-.02	-.01	-.66	.45	-.28	.05	-.52				
21. Mathematics Exam	-.05	.05	-.06	.04	-.07	.07	*.03*	.15	.15	.14	.02	.07	.04	.07	-.02	.06	.05	-.02	-.07	.01			
22. Statistics Exam	-.09	.08	-.09	.02	-.08	.06	*.02*	.10	.09	.07	.02	.06	.04	.04	.00	-.02	.04	-.04	-.04	-.03	.59		
23. Social Sciences Exam	-.06	.06	-.06	.07	-.11	.11	*.01*	.13	.06	.13	.03	.11	.07	.14	-.27	.23	-.03	-.04	-.26	.21	.49	.50	

Note. With current sample size, all correlations equal to or larger than .05 in absolute size are significant at .001 level. Goal Choice (7.) correlations in italics, given the insufficient reliability of this scale.

Table 2

Descriptive statistics of all scales, and gender difference statistics

	M	SD	Crombach α	Female M	Male M	Gender difference	
						t-value	D-value
1. Incremental Theory	4.57	1.17	.84	4.63	4.53	2.72	.08
2. Entity Theory	3.61	1.28	.83	3.56	3.63	-1.73	-.05
3. Implicit Theory	4.48	1.14	.90	4.53	4.45	2.37	.07
4. Effort Positive	5.26	0.74	.66	5.29	5.24	2.25	.07
5. Effort Negative	3.04	0.93	.72	3.04	3.05	-0.31	-.01
6. Effort Belief	5.11	0.69	.75	5.13	5.10	1.42	.04
7. Goal Choice	*4.27*	*0.84*	*.42*	*4.30*	*4.25*	*2.27*	*.07*
8. Learning Goal	5.43	1.06	.82	5.47	5.40	2.15	.07
9. Challenge Mastery Goal	4.75	1.23	.85	4.74	4.75	-0.29	-.01
10. Outcome Goal	5.81	0.91	.74	5.95	5.73	8.49	.25
11. Ability Goal	4.89	1.05	.72	4.98	4.84	4.58	.14
12. Normative Outcome Goal	4.55	1.38	.86	4.55	4.55	-0.08	-.00
13. Normative Ability Goal	3.50	1.45	.90	3.41	3.55	-3.15	-.10
14. Intrinsic Motiv. to Know	5.47	0.91	.79	5.58	5.40	6.64	.20
15. Intrinsic Motiv. to Accomplish	4.13	1.58	.93	4.20	4.09	2.16	.07
16. Intrinsic Motiv. Stimulation	4.40	1.26	.86	4.47	4.36	3.05	.09
17. Identified Motivation	5.88	0.80	.73	5.97	5.82	6.66	.20
18. Introjected Motivation	4.79	1.16	.79	4.83	4.76	1.88	.06
19. External Regulation	5.33	1.29	.77	5.33	5.32	0.08	.00
20. A-Motivation	1.86	1.23	.91	1.77	1.91	-3.71	-.11
21. Mathematics Exam	12.55	3.68		12.64	12.49	1.29	.04
22. Statistics Exam	12.54	3.21		12.38	12.64	-2.67	-.08
23. Social Sciences Exam	6.47	1.30		6.63	6.37	6.30	.20

Note. Goal Choice (7.) descriptive statistics in italics, given the insufficient reliability of this scale. *T*-values larger than 2.33 in absolute value are statistically significant at .01 level, and those larger than 3.29 at .001 level.

Table 3

Classification of subjects on implicit theory and effort belief scores, using M ± 1 SD

	Effort negative	Mixed effort	Effort positive	Total
Entity theorist	4.3%	12.2%	1.7%	18.2%
Mixed implicit	10.1%	46.5%	7.5%	64.0%
Incremental theorist	1.1%	9.7%	7.0%	17.8%
Total	15.5%	68.3%	16.2%	100.0%

Table4

Table 4

Standardized structural equation coefficients: standardized estimates of Gamma matrix in columns 1, 2; of Beta matrix in columns 3-20.

Latent factor	1.	2.	4.	5.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1. Incremental Theory																	
2. Entity Theory																	
4. Effort Positive	.67	.33															
5. Effort Negative	.44	.88															
8. Learning Goal			.46														
9. Challenge Mastery Goal			.35														
10. Outcome Goal			.57														
11. Ability Goal			.61	.18													
12. Normative Outcome Goal			.26	.08													
13. Normative Ability Goal	.32	.36															
14. Intrinsic Motiv. to Know			.23		.18			.20									
15. Intrinsic Motiv. to Accomplish					-.19	.18		.20									
16. Intrinsic Motiv. Stimulation			.18			.20		.17									
17. Identified Motivation			.18				.13		.11								
18. Introjected Motivation				.09				.44									
19. External Regulation				.06					.09								
20. A-Motivation				.05		.09											
24. Academic performance	-.12			-.10		.14			.17						-.09	-.16	

Notes. All estimates are statistically significant at .001 level. Third variable, Goal Choice, omitted from model.

Figure captions
Click here to view linked References

Fig. 1

Path diagram with standardized estimates of the structural equation model relating implicit theories and effort beliefs

Fig. 2

Distributions of the bipolar scores for implicit theory and effort belief

Many thanks for the constructive and concrete feedback. As indicated in the table, we adopted all comments. We have revisited the writing of the paper, focusing on restructuring complex sentences with too many (semi)colons. But thanks to the extensive reviewer feedback, many of these were also addressed by the reviewer comments.

COMMENTS FOR THE AUTHOR:	
The topic of this paper is important, but the paper itself is tedious and repetitive in parts, largely because no practical implications regarding education are ever discussed or pointed out. It would be good to have at the end of the paper a section on policy implications for education, and what is the contribution of this paper to school learning in particular.	Such a section is included. At the same time, this section is used to connect to a recent paper in SPOE on the same topic: The main implication of this contribution to the practice of school learning is related to this crucial role of effort. Dweck's monograph (1999) gave rise to school intervention programs directed at changing students' self-theories. Having students adopt an incremental theory of intelligence is at the basis of many of these programs (see e.g. Espinoza, Arêas da Luz Fontes, and Arms-Chavez 2014). Empirical outcomes of studies as Espinoza et al. (2014) suggest that beyond type of self-theory adopted, effort attributions of academic success by both students and teachers are important antecedents of learning behaviours. This study adds the crucial importance of another aspect of learning effort: the self-perception of students on the role effort plays in learning. Taking these two empirical outcomes together, and combining it with the more loose coupling of implicit theories and effort beliefs we find in this study than often hypothesized in frameworks of self-theories, suggests that intervention programs may profit from shifting some of their focus toward adapting effort beliefs and effort attributions, away from implicit theories.
The writing is moderate, with some awkward phrases and sometimes tortuous sentences. There is also an overuse of colons and semicolons. Pleease go over the paper carefully to ensure clarity and correct English..\	Done so, with a focus on simplifying composed sentences with subordinate clause, thus diminishing the number of colons and semicolons.
Please replace ampersands in the text citations with "and". However leave the ampersands in the bibliography as they	Done so

currently are.	
The following are some corrections/suggestions which merit your close attention.	
1. Page 2, correlations to two decimals is sufficient.	Suggestion implemented
2. Page 2, middle of page: The phrase should be enclosed within parentheses, or rewritten: "…see e.g. Brophy (2005), Hulleman, Schrager, Bodmann, and Harackiewicz (2010), Senko, Hulleman, and Harackiewicz (2011),…"	Suggestion implemented
3. Page 2, toward bottom of page: sentence needs a question mark: "…or can we do without that strict Dichotomy? "	Suggestion implemented
4. Page 2, toward bottom of page: Replace "in" with "on": "…take rather extreme positions on these two issues."	Suggestion implemented
5. Page 4, middle of page. Do not begin sentence with a number. Either spell out, or rephrase sentence. "63.3% of the students are male…." Please fix.	Suggestion implemented
6. Page 7, line 5: "mathematics & statistics" should be "mathematics and statistics".	Suggestion implemented
7. Page 7, mid-page: Replace "to" to "could". "All students consented that their data, in anonymous format, could be used…"	Suggestion implemented
8. Page 8, mid-page: Spell out e.g.: "…for example, Elliot and McGregor (2001),…"	Suggestion implemented
9. Page 8, mid-page: "on item-level" should be "at the item-level"?	Suggestion implemented
10. Page 9, Replace ampersand with and: "…RMSEA = .038 and 90% CI RMSEA…" Also found at bottom of page.	Suggestion implemented (4 times; p 9 2X and p. 14, 2X)
11. Page 11, line 5: Should behaviour be plural? "…evoke different goal-setting behaviours."	Suggestion implemented
12. Page 12, lower middle of page: Replace "neglecting" with "neglect": Should read: "Third: even if we permit ourselves to neglect the reliability problem…"	Suggestion implemented
13. Page 13, top line: Insert "and". Should read: "…correlate weakly and negatively with it…"	Suggestion implemented
14. Page 13, toward middle page: Should read: "…are more weakly related to these performance components…"	Suggestion implemented

15. Page 13, toward middle page: Social science I singular in this context. Should read: "…social science subjects…"	Suggestion implemented
16. Page 13, below middle page: " …opposite to what was expected…"	Suggestion implemented
17. Page 14, line 3. It isbetter if this is within parentheses: ´(see Table 2.). "	Suggestion implemented
18. Page 15, line 7: Replace "e.g." with "for example,"	Suggestion implemented
19. Page 15, paragraph 2: Not sure this is a sentence, and in any case it is very awkward: "…the incorporation of effort belief constructs as mediators of the relationships between implicit theories and other descriptions of human behaviour in achievement settings, such as achievement goal setting and academic motivation." Please rewrite.	Sentence rewritten: Our study suggests that a second amendment may have an even stronger impact: the incorporation of effort belief constructs as mediators. They mediate the relationships between implicit theories on the one hand, and other descriptions of human behaviour in achievement settings, such as achievement goal setting and academic motivation, on the other hand.
20. Page 16: Awkward sentence. Please rewrite and possibly break into two sentences. Also what does "relative novelty of applying mean? "The results of this study related to development of achievement goal theory, are in the relative novelty of applying Dweck's (1999) Goal Choice Items Questionnaire and Grant and Dweck's (2003) instrument for appearance and normative achievement goals."	Sentence rewritten: Related to the development of achievement goal theory, this study contributes in applying Dweck's (1999) Goal Choice Items Questionnaire and Grant and Dweck's (2003) instrument for appearance and normative achievement goals. Empirical studies based on these instruments are not numerous.
21. Page 16, middle of page. Replace "not" with "nor". "… neither in the complete sample, nor in any of the six different…"	Suggestion implemented
22. Page 16, awkward phrase: Replace "distinguish" with "differentiate" or something similar. "…and the circumstance that the six scales are sufficiently differentiated from each other."	Suggestion implemented
23. Page 17, end of first paragraph: Delete "as". "…suggestion in the Grant and Dweck (2003) study to merge both constructs into one factor."	Suggestion implemented